

Motor-Drive Thermal Sub-System Modeling

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FY05 Budget: \$ 0 K

FY06 Budget: \$ 400 K

Project Duration: FY06 to FY08

FreedomCAR APEEM FY05 Wrap-up/FY06 Kick-off Meeting

Oak Ridge National Laboratory

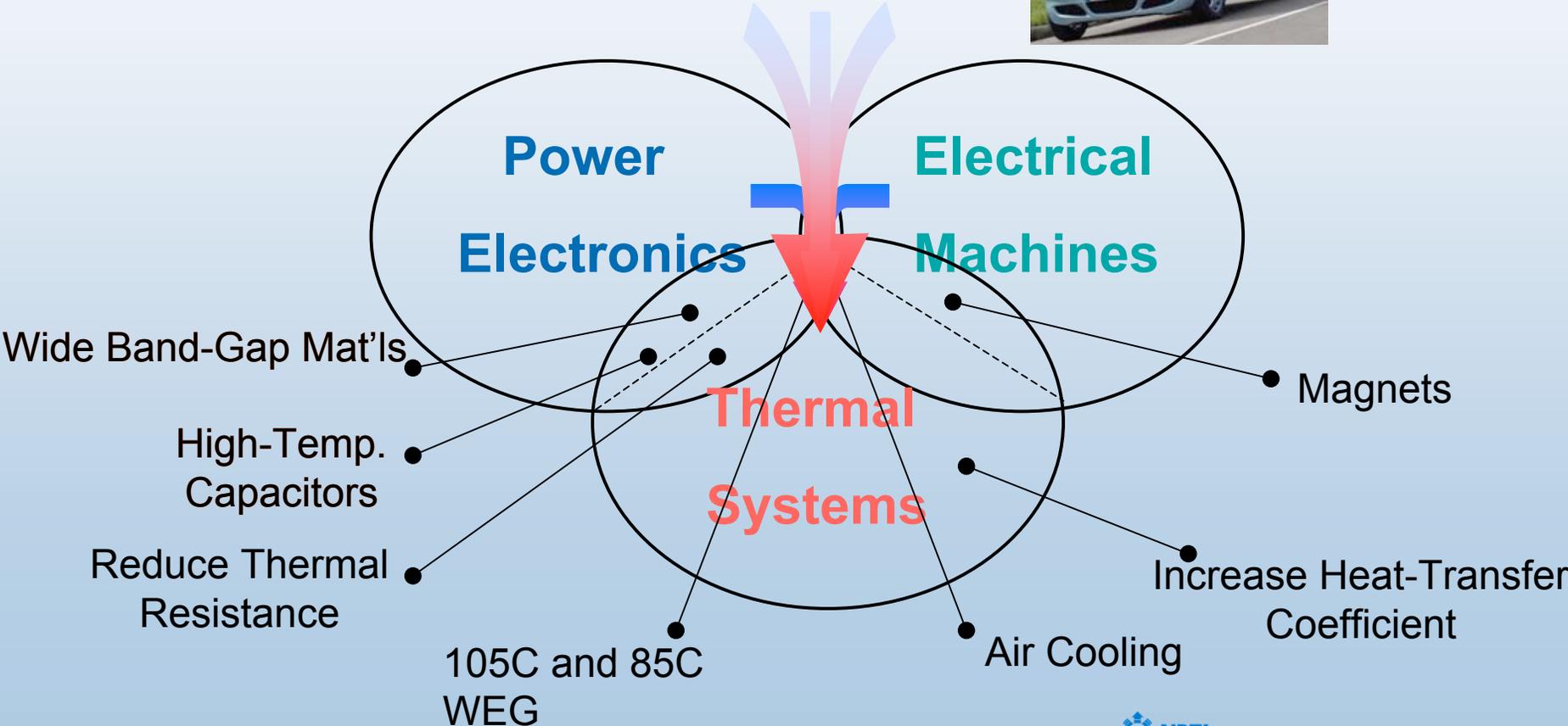
National Transportation Research Center



November 1, 2005

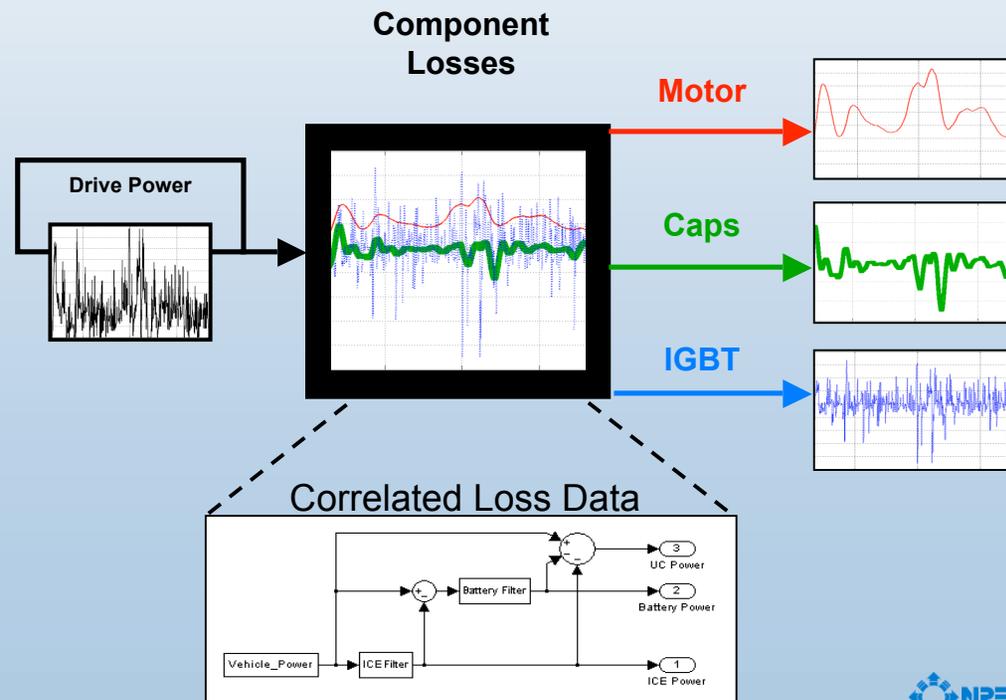


Where Does This Project Fit?

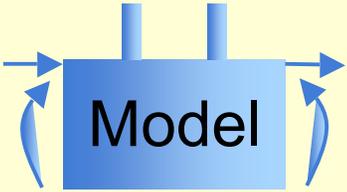


What is This Project?

- New Project for FY06
- The objective of this project is to simulate dynamic drive-cycle events in electric drivelines to comprehensively determine components' influence and impact on thermal design and operation under real operating conditions.



Technical Approach

Approach	The approach will include the following specific phases of design:
<p>1) Implementation Modeling/Co-simulation</p>	<p>1) Modified models and co-simulation tools will be applied to reconcile the modeling disparity between component specific operation and in-use system details;</p>
<p>2) Operation</p> 	<p>2) Accurate operating strategies will be developed (basic motor/generator operation from battery and ICE constraints) that represent enough operational details to be largely representative of real-world operation;</p>
<p>3) Losses</p>	<p>3) Heat generation and thermal modeling capability will be incorporated between the co-simulation packages that enable system level cooling strategy developments using the heating/cooling in the different vehicle loops;</p>



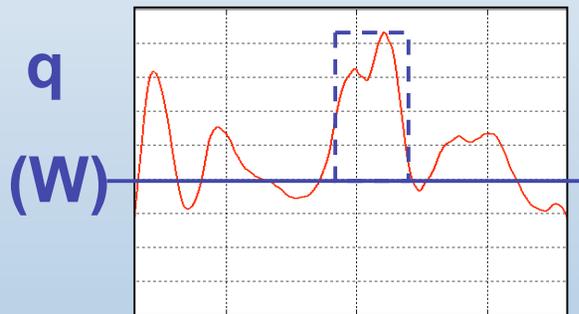
Technical Approach

<p>Approach 4) Validation</p>	<p>Continued 4) Parallel path design phase includes the system validation of simulations and analysis.</p>
<p>Positives: Increased Thermal Design Detail</p> <ul style="list-style-type: none"> • SS vs. Transient thermal solutions • Implementation specific variability in thermal performance 	<p>Design trade-offs can be further optimized with specific time and space based operational constraints.</p> <p>Thermal tool will determine goals/barriers variability depending on the vehicle architecture (FCV, 42V, Mild vs. Full HEV,...).</p>
<p>Negatives</p> <ul style="list-style-type: none"> • More specific details must be simulated 	<p>Relevant platforms must be considered and representative operation developed.</p>

Goal

- Produce accurate, dynamic component heating data for specific FCV/HEV architectures based on various loss mechanisms and during in-use profiles.

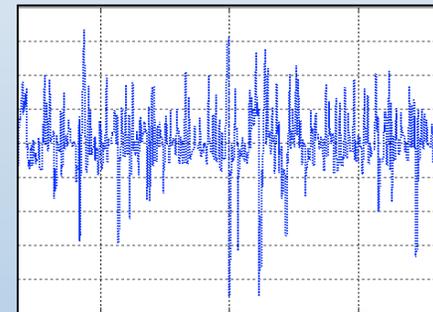
Motor



Caps



IGBT



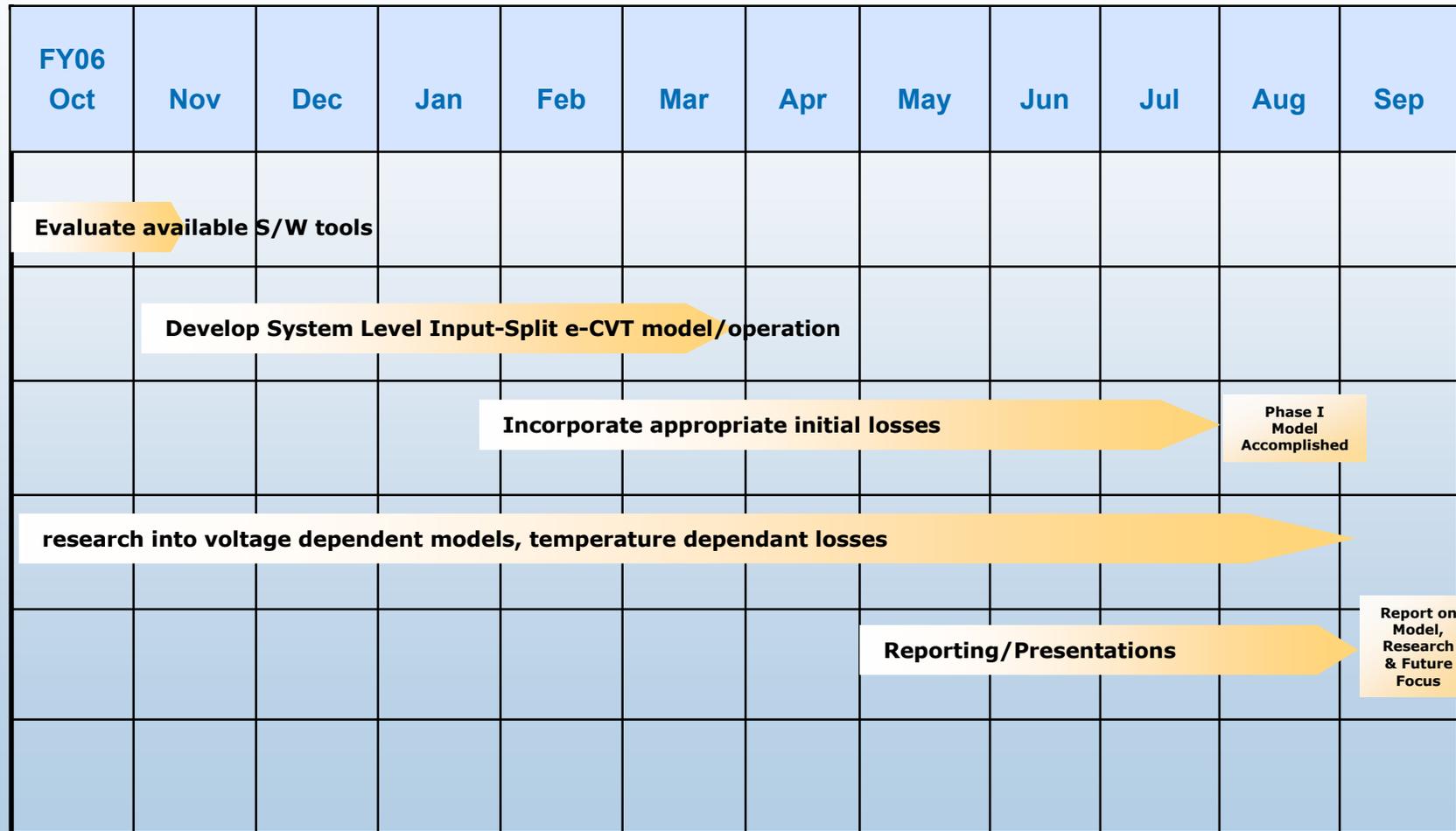
Approach for FY06

- Software tool evaluation – adapt and leverage existing tools to perform target analyses
- Architecture specific simulation - Develop a sub-system level HEV architecture model that represents the single-mode (input-split) eCVT, including motor-drive and gearing

Approach for FY06

- Incorporate appropriate initial losses - First order losses in the motor/inverter, such as speed and torque dependence.
- Investigate voltage dependent models, & temperature dependant losses to be incorporated in next research phase.

Timeline for FY06

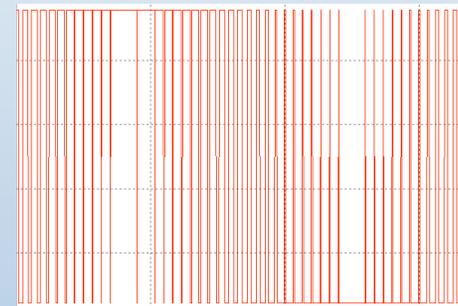
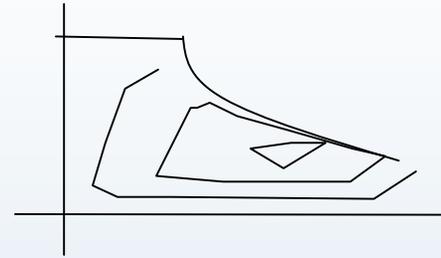


Key task

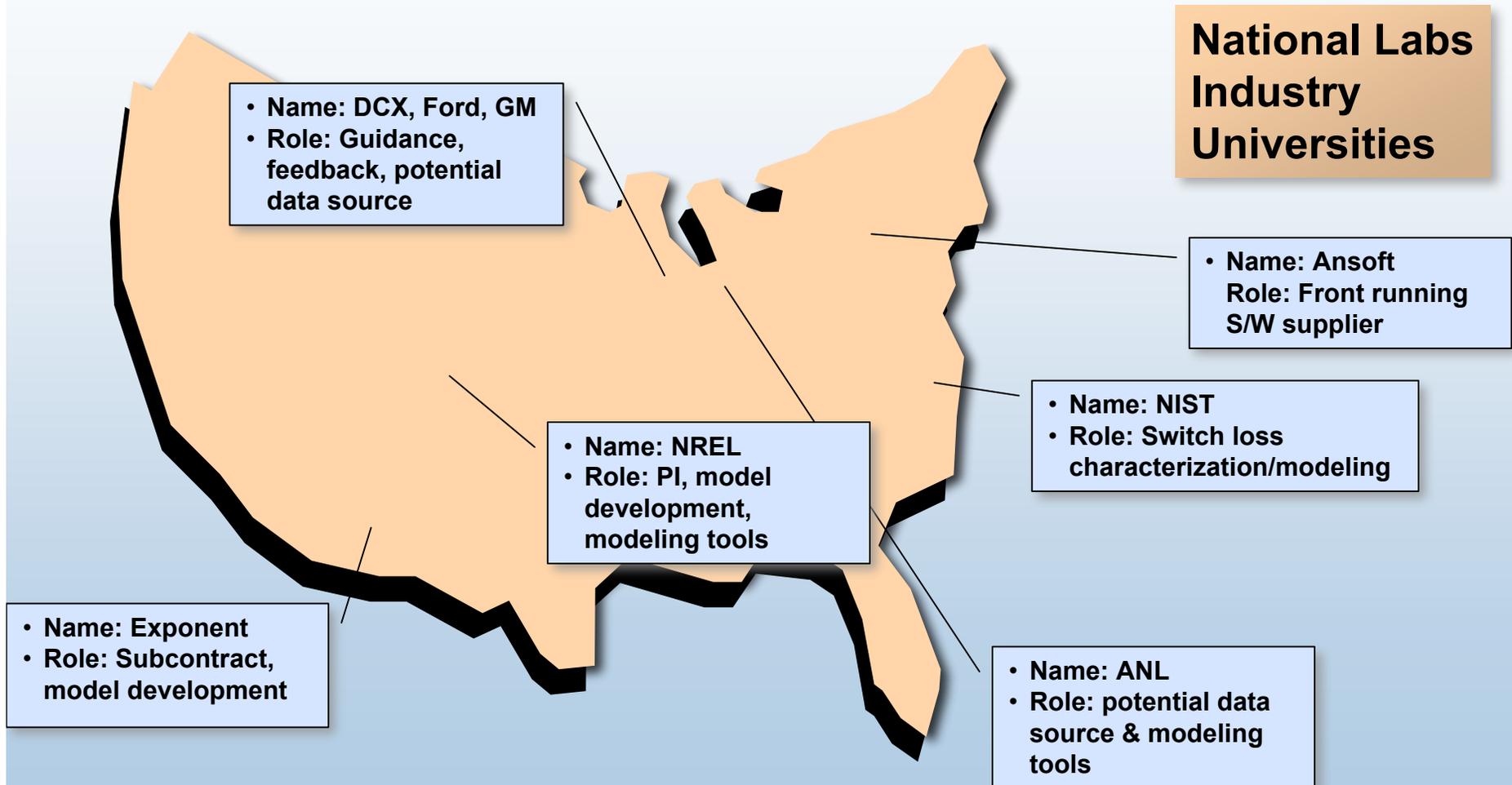
Milestone/Deliverable

Barriers/Challenges

- Barriers: Data availability for component characterization
- Challenges: Capture all relevant component level details, while simulating at an architecture level of operation.



Interactions and Collaborations



Questions

